

Giant Salvinia - Risk Assessment for Arizona



{JPEG Photos
from web}



Name

Giant Salvinia (*Salvinia molesta*) - Also referred to as “Kariba weed”, “water fern”, “African pyle”, “Australian azolla”, “water spangles” or simply “floating fern”.

Description

Giant salvinia is a floating fern from southeastern Brazil and one of the world's worst aquatic weeds. This plant first appeared outside of cultivation in the United States during 1995 in southeastern South Carolina (Johnson, 1995). That infestation was eradicated but it next appeared in Houston, Texas in May 1998 and in Louisiana during that same year. By 1999 and 2000 it had been found in Alabama, **Arizona**, California, Florida, Georgia, Hawaii, Mississippi, North Carolina, and Oklahoma (Jacono *et al.* 2001). It is still available for purchase in the USA through Internet purchasing on the World Wide Web and continues to extend its range across the Atlantic coastal plain, from southeastern Virginia to south Florida, west across the Gulf coast states, into limited areas on the lower Colorado River and into central California, a range similar to, but broader than, water hyacinth since it is more cold tolerant (Room 1995).

The giant salvinia plant consists of a horizontal stem that floats just below the water surface. The stems produce a pair of floating leaves with a third submersed leaf at each node. The floating leaves are ovate to oblong in shape, while the root-like submersed leaf is highly dissected. Plants

display several growth forms, depending upon their stage of maturity and the phenological development of the mats. Individual leaves range from a few millimeters on primary stage plants to 4 centimeters long on the tertiary stage plants. During the primary stage plants are smaller with their leaves lying prostrate on the water surface. As plants grow, the leaves elevate in response to crowding (the secondary stage). Eventually, in the tertiary stage a vertical leaf position is attained as the mature plants compress into tight chains and form extensive floating mats. Abaxial leaf surfaces bear rows of trichomes that branch into two to four papillae which rejoin at the tips, forming a structure said to resemble an "egg beater" or "bird cage". These trichomes trap air and thereby create a water-repellant surface. Submersed leaves are filamentous, root-like, and often bear chains of sporocarps.

Upper surfaces of green leaves are covered with rows of white, bristly hairs. The stalks of each divide into four thin branches that soon rejoin at the tips to form a cage. The resulting structures resemble tiny eggbeaters. Cage-like hairs may be damaged on mature leaves, thereby not appearing true to this description. Young, unfolding leaves will, however, reveal intact structures. These specialized hairs create a water repellent, protective covering.

Life History

Giant salvinia is a free-floating aquatic fern with a horizontal rhizome just beneath the water surface (Room 1995). Each plant is a colony of ramets. Each ramet consists of an internode, anode, a pair of floating leaves, the submerged 'root', and associated buds. The 'root' is a modified leaf that looks and functions like a root. Salvinia is morphologically variable primarily in response to the level of crowding and availability of nutrients; two factors that are largely independent of one another. There are three growth forms, with a continuum among them, associated with the degree of crowding experienced by the plant (Mitchell and Tur 1975)

- The primary form occurs as isolated plants in the initial 'invading' stage of an infestation. This form has small, oval leaves less than 15 mm wide that lie flat on the water surface.
- The secondary form is an intermediate form that occurs after plants have been growing over open water for some time, either freely or on the edge of stable mats. Internodes are longer, with larger, boat-shaped (slightly keeled) leaves that have rounded apices and that are variable in size but are normally between 20 cm and 50 cm wide. The entire lower leaf surface is in contact with the water.
- The tertiary form occurs when plants are growing in crowded conditions associated with mature infestations. Internodes are short with large heart-shaped, or oblong and deeply keeled leaves up to 60 mm in width when fully opened (Fig. 8). The undersides of adjacent leaves are in contact with each other.

Reproduction or Reproductive Strategy

Giant salvinia is pentaploid, has a chromosome number of 45, and is incapable of sexual reproduction (Loyal and Grewal 1966). It effectively reproduces through vegetative means. Stems fragment spontaneously as plants mature. New branches develop from apical and lateral buds. Each node harbors up to five serial lateral buds (Lemon and Posluszny 1997), adding to the high potential for growth and dormancy. Giant salvinia will withstand periods of stress, both low temperature and dewatering, through latent buds. Growth is apically dominant and progresses by

expansion of apical and axillary buds, the latter forming branches. New plants can form when older plants break apart due to senescence or damage (Room 1983).

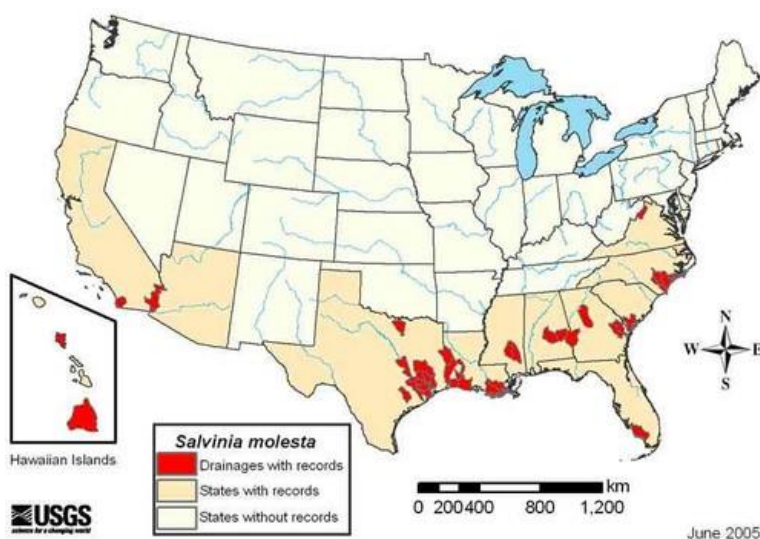
Environmental Tolerances and Restrictions

Giant salvinia demonstrates a wide tolerance from hot, dry air conditions to freezing air temperatures, but cannot withstand ice formation on the water surface (Whiteman and Room 1991). It is strictly a freshwater species, not tolerating brackish or marine environments. In experimental trials, salinity above 7 parts per thousand (ppt) retarded growth and damaged plant tissues. Higher salt concentrations proved lethal. Plants maintained at 11 ppt were killed after 20 hours exposure. At 20 ppt, mortality resulted in less than 1.5 hours. Full strength seawater (34 ppt) killed plants in 30 minutes (Divakaran et al 1980).

Preferred Habitat

The actual native range of this *Salvinia* is a relatively small area (20,000 km²) in southeastern Brazil, including the states of Sao Paulo, Parana, Santa Catarina and Rio Grande do Sul. It prefers lagoons, artificial dams, swamps, drainage canals, and along the margins of rivers and other waterbodies (Forno and Harley 1979).

Distribution



Current Status in Arizona

On August 4, 1999 the U.S. Fish and Wildlife Service found giant salvinia in the Imperial National Wildlife Refuge on the Colorado River. Plants were also seen floating down the Colorado River, on the Cibola National Wildlife Refuge, in Pretty Water and Three Finger Lake. Subsequent investigation determined that the source of the infestation was the West Side/Outfall Drain of the Palo Verde Irrigation District (PVID) near Blythe, California. Since that discovery a series of activities have taken place in an attempt to control and eradicate the giant salvinia.

These activities include the placement of a barrier above Walters Camp in the old river channel and intensive herbicide application, and clearing of PVID=s West Side Drain. These efforts had not proven fully successful in eradication, but afforded some control. During the winter, as water temperatures decreased, the salvinia dies back in most cases. In early 2003, a biological control agent named *Cyrtobagous salviniae* (Salvinia weevil) was reared and released in four states – California, Arizona, Texas, and Louisiana. This weevil has proven to be effective at controlling, but not eradicating, giant salvinia.

Pathways

Giant salvinia is a free-floating plant and can be dispersed by passive means (water currents and wind) and by "hitchhiking." Animals may carry the plants over short distances, but humans can spread it widely on fishing gear and boating equipment. Intercontinental dispersal and dispersal within the United States has probably occurred when this highly invasive plant was sold in the nursery trade, either intentionally as a plant for aquaria or for ponds, or unintentionally when it "hitchhiked" with other aquatic plants collected for academic study or for use in aquaria or ponds. In essence, human movement have been the main cause of wide-spread invasive infestation.

Known/Potential Impacts

Giant salvinia is one of the world's most noxious aquatic weeds and is notorious for dominating slow moving or quiet freshwaters (Mitchell et al 1980). Its rapid growth, vegetative reproduction, and tolerance to wide-ranging environmental stress make it an aggressive, competitive species known to impact aquatic environments, water use and local economies. Under optimal conditions (light, temperature and nutrient) in the laboratory, plant populations have been found to double in size every 2-4 days (Gaudet, 1973). Under favorable natural conditions, biomass doubled in about one week to 10 days (Mitchell and Tur 1975; Mitchell 1979). A single plant has been described to cover forty square miles in three months (Creagh 1991). Biomass weights of live plants approach those recorded for water-hyacinth (*Eichhornia crassipes*) (Mitchell 1979).

Giant salvinia has the potential to alter aquatic ecosystems in several ways. Rapidly expanding populations can overgrow and replace native plants. Resulting dense surface cover prevents light and atmospheric oxygen from entering the water. Meanwhile, decomposing material drops to the bottom, greatly consuming dissolved oxygen needed by fish and other aquatic life (Thomas and Room 1986).

Benefits

None noted in any research and/or publications outside of its native range.

Effective Treatments

Mechanical control is the least effective approach for giant salvinia control. The mobility of free-floating plants, rapid growth, and large biomass production combine to frustrate most mechanical control attempts. Physical removal of the plants requires constant vigilance and repeated efforts and is not sustainable in larger water bodies. Chopping and shredding the plants will actually

increase the risk of spread by creating many more smaller plants and fragments, many of which may still be viable. Herbicides have limitations because they may impact non-target plants, salvinia infestations are not easily located or even accessible, and direct costs can be very high (from \$85 [Reward®] to \$350 [Sonar®] per acre). Use of the nonselective herbicides available for control of giant salvinia will likely cause temporary declines in emergent, floating and submersed macrophytes, phytoplankton, and aquatic invertebrates in treated areas.

However, *Cyrtobagous salviniae* (Salvinia Weevil) is highly host-specific and will not have direct negative impacts on native plant species. Post-release observations in many countries have indicated that *C. salviniae* does not damage non-target plants and is specific only to *Salvinia* spp., of which there are no threatened or endangered species in the Salviniaceae family. The efficacy of these weevils in the lower Colorado River has been high at suppressing and controlling giant salvinia in California and Arizona. Insectories in Texas can make these weevils available for future outbreaks or infestations. However, supplementation of the current weevil populations may still be a viable mitigation technique, but the intrastate transport permit has apparently expired. Future efforts should be coordinated through the U.S. Fish and Wildlife Service in Albuquerque, New Mexico.

Recommendation

Through Arizona Game and Fish Department Directors Order {A.R.S. §17-255.01(B)}, list giant salvinia (*Salvinia molesta*) as an aquatic invasive species in Arizona, with subsequent affected waters listing and mandatory conditions for movement.

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